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ABSTRACT

The Northwest Regional Educational Laboratory presents a primer for making educational decisions more systematic, containing a collection of (1) prescriptive guides for clarifying problems and objectives, (2) suggestions for identifying possible solutions, (3) criteria for judging solutions, (4) methods for measuring values, and (5) strategies for combining these elements to reach a decision. An annotated bibliography of nine sources from 1953 to 1981 is included. The appendices discuss alternatives to decision analysis procedures and the measurement of costs. (PN)

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Research Evaluation Program

No. 83 A PRIMER ON DECISION ANALYSIS PROCEDURES

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June 1983

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PREFACE

The Research on Evaluation Program is a Northwest Regional Educational Laboratory project of research, development, testing, and training designed to create new evaluation methodologies for use in education. This document is one of a series of papers and reports produced by program staff, visiting scholars, adjunct scholars, and project collaborators--all members of a cooperative network of colleagues working on the development of new methodologies.

What procedures are available for making educational decisions more systematic? This primer contains a collection of (a) prescriptive guides for clarifying problems and objectives, (b) suggestions for identifying possible solutions, (c) criteria for judging solutions, (d) methods for measuring values, and (e) strategies for combining these elements to reach a decision. The thoughtful use of the procedures outlined in this primer can formalize and improve decision making within educational organizations.

Nick L. Smith, Editor
Paper and Report Series

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CHAPTER 1: PRELIMINARIES

I keep six honest serving men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.

Rudyard Kipling

WHAT is This Primer About?

DAP. DAP represents Decision Analysis Procedures, or, if you prefer a less prosaic explanation, DAP is short for "dapper", which means neat and stylish. The procedures presented in this primer are not original. They are taken from many disciplines, such as operations research, psychology, economics, and management science, and represent a more systematic approach to decision making than customarily practiced by most educators. DAP are prescriptive and concerned with how to make decisions rather than being descriptive and concerned with how decisions are usually made. DAP include guides for clarifying problems and objectives, suggestions for identifying possible solutions, criteria for judging solutions, methods for measuring values, and steps for putting it all together and arriving at a decision.

WHY This Primer? WHY DAP?

Solving problems and making decisions is difficult and stressful work. As Linus, the Peanuts cartoon character said to Charlie Brown:

I don't like to face problems head on.
I think the best way to solve problems
  is to avoid them.
This is a distinct philosophy of mine.
No problem is so big or so complicated
  that it can't be run away from.

People are affected by what we decide and do. Problems are complex. Yet, in our professional roles, judgment and decisions must be made and not "run away from". Many of our actions are

"Howard, this is one of the toughest decisions I've ever had to make."

United: The Magazine of the Friendly Skies, October 1982.

more instinctive than reasoned. But our common sense should tell us that we cannot always rely on our common sense. We believe that the DAP described in this primer can improve decision making. Although some of the procedures involve arithmetical operations that yield numerical estimates of the value of decision alternatives, the overall aim of the DAP is not numbers but greater insight into the problems we face and the possible solutions we have to solve them.

WHEN Should the DAP be Used?

We believe that at least some of the procedures are appropriate for making any important decision. Although personal decisions (for example, which program to enroll into, how to distribute your time among competing activities) are covered by the procedures, the orientation is toward organizational concerns (how to run the language laboratory, which textbook to purchase).

The procedures are best suited when people wish to reason together in good faith as they identify and evaluate goals and decision alternatives. The parties can have different roles and values, the goals can be ill-specified, the information can be incomplete and imperfect, and the criteria by which the adequacy of any solution is to be judged can be many and varied.

WHO is this primer for?

Decision makers. Although all of the examples will be educational, anyone who participates in making decisions may benefit from the primer and the DAP.

WHERE Does Cost Analysis Fit into the DAP?

Decision makers should be clear about their problems, identify attractive decision alternatives, and evaluate the expected consequences of implementing these alternatives. In evaluating these possible courses of action, all important consequences should be considered. Financial cost is usually one such consideration. Student learning and satisfaction, teacher acceptance, space and other requirements, and the match to school philosophy/objectives are among many other consequences that can serve as criteria for evaluating decision alternatives. Thus, the DAP are broader than cost analysis, both because they encompass a greater portion of the decision making process, and because they treat cost as only one of many criteria to be applied in the evaluation of alternative courses of action.

HOW Might This Primer be Used?

It is suggested that the reader proceed through the entire primer. Checklists, steps to be followed, examples, and other material that are most suited as a future reference are placed as separate figures for easy identification as needed.

CHAPTER 2: ABOUT DECISIONS

Decision Contexts

Decisions and the decision process have political, moral, economic and socio-psychological components.

Decisions sometimes take place in highly political contexts in which choices are based on influence, power, position, ambition, pressure, badgering, negotiation, and gamesmanship. Procedures for decision making in such contexts are not addressed in this primer. Conflict over goals and values can occur in the situations considered here, but such conflict is expressed in settings more akin to a participatory democracy in which consensus is sought even if it is not attained.

Decisions take place in a moral context in which choices are based on oughts and shoulds, duties and obligations, and rights and wrongs. Moral and ethical concerns manifest themselves in the DAP as they influence the choices considered and the evaluation of these choices.

Decisions take place in an economic context in which choices are based on benefits and costs, supply and demand, income and expenditure. As stated above, economic (cost) implications are treated in the DAP as one of possibly many consequences of a decision to be evaluated.

Decisions take place in a socio-psychological context in which choices are based on the interplay among actors—on their values and needs and feelings. Such interplay figures heavily in the DAP described in this primer.

Decision Making in Practice

Two extreme decision making styles can be described. In one, the decision techniques are ideosyncratic, ad hoc, and inelegant. Decision makers rely on intuition, good judgment, and experience. In the other, the techniques are mathematical, mechanical, and elegant. Decision makers rely on analytical thinking, mathematical models, and classical rationality.

As one writer cynically puts it, in the first approach decision makers act before thinking, if they ever think; in the second approach they think before acting, if they ever act. Psychologists and sociologists are fond of describing how decisions emerge, and they conclude that, although most procedures followed lie between the casual, flying-by-the-seat-of-the-pants and the studied, number-crunching styles characterized above, more often than not they are closer to the former than the latter.

The present can be the enemy of the future, and the way important decisions are now made need not be the way they should be made. The DAP shift the emphasis toward the analytical style. But the power of both styles is recognized, and DAP incorporate the seasoned, experienced judgment of the first with the analytic, rational style of the second. The DAP back away, however, from the casual, capricious approach of some decision makers and from the preoccupation of operations-research and management-science experts with sophisticated mathematical models and with estimating probabilities.

DAP consider decision making as a problem solving task in which problem clarification, information, and creative solutions

"Now, that's a welcome sight! I was just beginning to miss decision-making."

New Yorker, September 28, 1981.

are required, and in which consequences and utilities merge to produce an evaluation of the decision choices. DAP attempt to "...clear away the verbal underbrush and expose the path to decision." (Bross, 1953, p. 257) They force concentration on the essentials of the decision: options, criteria, and values.

Implicit in the DAP is the belief that the making of important educational decisions should be a cooperative effort. "Every competent boss has a staff whose views he respects and whose values he regards as relevant." (Edwards, 1977, p. 327.) Whether or not the process is cooperative, it does involve many parties.

> ...decisions that become official when ratified by the managers assembled in one room are the result of a collective process that has taken place in many rooms. And, after the "manager" has spoken, many voices in many other rooms will determine what happens. (Cronbach, 1980, p. 85.)

Having others participate in decision making has pluses and minuses. "The rationalist ideal of efficiency is in tension with the ideal of democratic participation." (Cronbach, 1980, p. 95) Duke et al. (1980) studied the perceived costs and benefits of teachers' involvement in shared decision making. Teachers saw the major cost to be increased demand on their time. Better feelings of doing something important, a strong sense of shared ownership, and greater satisfaction in fulfilling their "right to participate" were listed as benefits.

Radford (1977) suggests that decision makers dealing with complex models adapt procedures that include:

> (a) simplifying the problem and selecting a course of action that is judged good enough rather than optimal;
> (b) avoiding uncertainty or taking steps to reduce the effect of uncertainty on the outcome of their decision;
> (c) concentrating on incremental measures rather than those involving fundamental and large changes; and
> (d) placing emphasis on communication and participation in an endeavor to reduce the effects of conflict...(p. 16)

The DAP recognize the usefulness of practical procedures like these. But they also affirm the worth of more analytic procedures in which personal values are made explicit and the merit of each decision alternative is judged systematically.

Steps in the Decision Process

Descriptions of how to make decisions: how to solve problems; or how to think, evaluate, plan or engage in systems analysis all seem very much alike. For John Dewey, the questions to ask are: What's the problem? What are the alternatives? Which alternative is best? For Herbert Simon, the stages are intelligence gathering, designing (inventing and analyzing alternatives), and choosing. The DAP assume that the decision steps are similar to those shown in Figure 2.1.

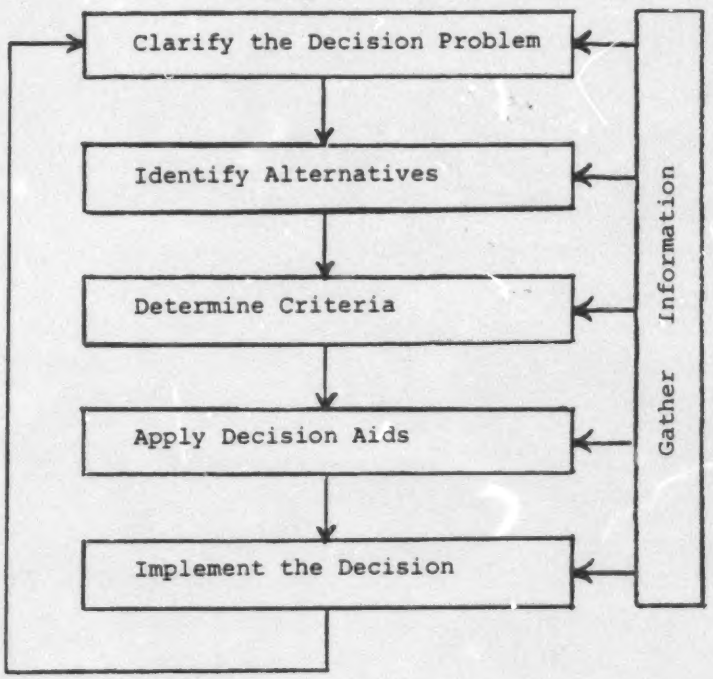

Figure 2.1 Example of a decision process.

Clarifying the problem at hand can be the most important step, because a solution to the wrong problem, no matter how creative or elegant, is worthless. According to Dewey, "A problem well stated is half solved." The decision problem will more likely be well stated if it is written out.

A tension exists between stating a decision too broadly, so that it can't be dealt with effectively, and too narrowly, so that attractive courses of action are excluded from consideration. The umbrella decision, how to improve the school, would be more manageable if it were limited to improving some aspect of the school, such as teacher morale. On the other hand, a decision about which school to close may be too narrow and restricting. A more appropriate question might be how to cut a specified dollar amount from the school budget.

Asking "Why?" is a powerful heuristic for uncovering underlying issues and values and for exposing those decision problems toward which one's focus and effort should be directed. Why do we need a change? Why is there a problem? Why do we want to make this decision? When "Why?" is applied to a question such as which computer to buy, the purposes for the purchase are elicited and a more basic and less restrictive question might be revealed, such as, "How should the block grant allocation be spent?"

Frequently questions are phrased in terms of goals and objectives, such as, "How can we increase student learning?" Decisions deserving priority are those affecting the school's most important goals. To avoid closing off options needlessly, a statement of goals should avoid mentioning possible solutions. Thus, it would be better to ask how to keep the classrooms comfortable rather than how to raise the temperature to 68 degrees, because eliminating drafts and increasing humidity might be more effective solutions than raising the temperature.

In short, the way in which the decision problem is stated limits the solutions or alternatives that are considered and, consequently, the way in which the decision is resolved. But even a well-clarified decision problem admits many choices of action. Since a "decision" itself is a choice among alternatives, it can be no better than the alternatives considered. Suggestions for identifying alternatives, the next step shown in Figure 2.1, are offered in Chapter 3.

Evaluation of the alternatives encompasses two steps. The first, dealt with in Chapter 4, is to determine the factors or criteria to serve as the basis for the evaluation. The second is to apply procedures for arriving at a numerical indicator of value for each decision alternative. For this step, dozens of decision aids have been suggested. Models and techniques, mathematical and otherwise, abound. (See Hwang and Yoon, 1981, for a taxonomy of Multi-Attribute Decision Making (MADM) techniques, many of which use Utility Theory (MAUT). A set of procedures that is analytic, defensible, and manageable is described in Chapter 5.

Deciding is not the same as doing; implementing the decision is an additional step in the decision process. (See Figure 2.1.) Discussion of how to carry out decisions once they are made, however, is beyond the scope of this primer.

The feedback arrow looping back to the first step is included to remind us that the decision-making process is not terminal; the end point of one cycle can be the starting point for another. The work of educators proceeds incrementally. One decision begets another.

Also presented in Figure 2.1 is the view that information can apprise all stages of the decision process. The term "information" is used broadly to include not only facts--numerical or otherwise, current or historical--but also expert opinions, value preferences, and prediction of outcomes. Information may be gathered by any of a large number of techniques--formal or informal, objective or subjective. An excellent resource guidebook for educators on information useful for decision making has recently been published (California State Department of Education, 1983.)

DAP seek to pool the information available and to apply a wide range of data, experience, and judgment to the decision process. One objection to the DAP being presented in this primer is that the input facts and opinions may not be very accurate. "Garbage in, garbage out" is the caveat frequently heard when

analytical models are discussed. However, these fallible input data are the same ones that would be employed even if a less analytic method were used.

Most decisions are not of sufficient importance to be made following the steps shown in Figure 2.1. Making decisions analytically costs money and time. These investments must be balanced not only by any incremental gain that might accrue from identifying and choosing a good option over an inferior one, but also by any side benefits that are expected to result from following the DAP. These benefits include the comfort that corroboration of unaided intuition can provide; the increased insight of the staff into a complex situation and the trade-offs involved; and the improvements in communication with and acceptance by staff of a particular decision when the areas of disagreement and the justification for the chosen option are made explicit.

Of the six decision-making activities shown in the rectangles of Figure 2.1, only the middle three are discussed in further detail in the chapters that follow. This selection is not because these activities are more important than the others, but because a more limited focus of this primer is desired.

CHAPTER 3. IDENTIFYING ALTERNATIVES

What is a double petunia?
A petunia is a flower like a begonia.
A begonia is a meat like a sausage
A sausage-and-battery is a crime.
Monkeys crime trees.
Tree's a crowd.
A crow crowd in the morning and made a noise.
A noise is on your face between your eyes.
Eyes is opposite from nays.
A colt nays.
You go to bed with a colt, and wake up in the morning
with a case of double petunia.

Author unknown

A decision implies a choice among alternatives. No decision is necessary when a single option is available. ("Alternatives", "options", "choices", "strategies", "potential actions", and "solutions" are used interchangeably.) The alternatives do not have to be distinct educational programs. Having no program at all is an alternative. Different levels of financial support of the same program are alternatives.

The identification of only inferior alternatives will, in turn, produce an inferior decision, as will failure to consider an outstanding strategy. Because the choices considered limit the quality of a decision, it is important for decision makers to know techniques for generating and identifying such choices.

Suggestions for Identifying Decision Alternatives

Making educational decisions differs from selecting greeting cards in a stationery store, because with educational decisions all the options are not conveniently laid out. Technically, an infinite number of options exist, and only a small fraction are known to the decision maker. Eight groups of ideas for generating and identifying alternatives are discussed below and listed in Figure 3.1

1. Understand and analyze the decision to be made.

2. Consider choices made in similar or analogous decisions.

3. Employ a checklist of questions.

4. Challenge alleged constraints.

5. Avoid two-option scenarios.

6. Use your imagination.

7. Solicit advice from others. (See Figure 3.3 and related text for one approach.)

8. Piggyback on the ideas of others.

Figure 3.1 Suggestions for generating decision alternatives.

1. Understand and analyze the decision to be made. Options flow from the decision problem and from the goals lurking behind it. The decision and these goals serve as guideposts and boundary markers for locating and assessing the decision choices, the strategies for attaining the goals. Dissect the goals into subgoals and think of ways to achieve each subgoal. Analyze the situation. Ask such questions as, What are the parts to the problem? What must happen first? Next? What is required? How can it be attained or made to occur? What depends on what? Why is there a problem? Appreciating the reasons for the decision and being able to sense what in the present situation is unsatisfactory or in need of change can suggest solutions for remedying the problem.

2. Consider choices made in similar or analogous decisions. Are there historical precedences? Have you or others made similar decisions successfully before? (Don't hesitate to call on your own past experience.) What general class of decision problem are you facing? (Look for the powerful verbs in the problem statement.) Is it an allocation problem? a search

problem? a time management problem? an adjustment, purchasing, or communication problem? Gather information on how such problems are dealt with by others--even by those outside the field of education.

3. Employ a checklist of questions. A systematic approach to generating options is to progress painstakingly through lists of questions that are directed to existing or previously thought of strategies. Some questions were identified above. Other questions, designed to suggest variations on present practice or products, are shown in Figure 3.2.

4. Challenge alleged constraints. Don't let false restrictions suppress you from generating attractive solutions. Are the constraints about the decisions (goals), resources, and processes real? For example, is the decision really about which teacher to hire or about staffing patterns more generally? Is a specified dollar amount the true upper limit of the resources, or can other funds be relocated or secured through avenues not considered? Are the policies, social mores, and public opinion that apparently rule out selected processes imagined or real? Restate constraints in terms of functions rather than in terms of objects. "Enclosure" is less constraining in the number of admissible options than is "fence". How to maintain "discipline" is a less constraining goal than reducing "noise".

5. Avoid two-option scenarios. Thinking in terms of dichotomies is commonplace: yes or no; buy new uniforms or not buy new uniforms; hold a junior dance or not hold one this year; have a 4-day week or a 5-day week; adopt the new program or not. But rarely do only two options exist. Many attractive choices are usually available, and they should not be overlooked. For example, in addition to adopting the new program or not adopting it, other choices are: (a) postpone the decision; (b) adopt the program on a trial basis (limited time, limited number of sites, or limited in degree); (c) adopt the program contingent on other conditions being met; (d) adopt the program, but not until the year after next; and (e) adopt the program in principle, but with some features changed. Classes of options beside "yes" and "no"

Put to other uses? New ways to use as is? Other uses if modified?

Adapt? What else is like this? What other ideas does this suggest? Does past offer parallel? What could I copy? Whom could I emulate?

Modify? New twist? Change meaning, color, motion, sound, odor, form, shape? Other changes?

Magnify? What to add? More time? Greater frequency? Stronger? Higher? Longer? Thicker? Extra value? Plus ingredient? Duplicate? Multiply? Exaggerate?

Minify? What to subtract? Smaller? Condensed? Miniature? Lower? Shorter? Lighter? Omit? Streamline? Split up? Understate?

Substitute? Who else instead? What else instead? Other ingredient? Other material? Other process? Other power? Other place? Other approach? Other tone of voice?

Rearrange? Interchange components? Other pattern? Other layout? Other sequence? Transpose cause and effect? Change place? Change schedule?

Reverse? Transpose positive and negative? How about opposites? Turn it backward? Turn it upside down? Reverse roles? Change shoes? Turn tables? Turn other cheek?

Combine? How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?

Figure 3.2 Questions to elicit decision alternatives. (From Osborn, 1963, pp. 286-287.)

include doing nothing, applying a different remedy, applying many remedies, starting over, and getting rid of a troubling situation.

6. Use your imagination. Be original. Be far out. Consider ideals. Day dream. Ask, What if? Contemplate, speculate, theorize, ponder. Break free from the traditional. Let the stream of consciousness flow. Be creative.

7. Solicit advice from others. Ask other people for ideas. Experts are good sources but don't limit yourself to them. Other administrators, teachers, students, special interest committee members, and disinterested parties may all be helpful. Brainstorming, one approach for drawing out suggestions from others, is discussed in the next part of this chapter.

8. Piggyback on the ideas of others. Three modes for building on the choices suggested by others are associations, variations, and combinations. Free associate and/or produce chain reactions. (Recall the answer to the double petunia question at the beginning of the chapter.) Exaggerate. Figure 3.2 lists questions that encourage variations. Combinations can emerge by putting together parts of two or more strategies and forming different arrangements. For example, an instructional program contains materials, staff, students, content, etc. List elements under each component; that is, list the options for materials, staffing, etc. The procedure then consists of generating new suggestions for an instructional program by forming different combinations of the elements, a procedure which is like dressing up a paper doll with various combinations of hats, dresses, and shoes.

Brainstorming

If two heads are better than one, are several heads better than two? Many would answer "yes", at least if the task is the creative one of identifying decision choices. Brainstorming is a procedure in which several individuals, thinking together, offer as many choices of actions as they can.

Brainstorming is recommended when many solutions or strategies can be discovered or invented, when the preferred

option is not purely a matter of judgment, or when the alternatives are not already known. Thus, brainstorming is appropriate for a question such as, What is the best way to...? Brainstorming is not appropriate for questions such as, When is the best time to...? or, How much should we...? The decision problem should be sufficiently narrow that solutions can be forthcoming. However, if the decision problem tends to be broad in scope, it may be possible to divide the problem into component parts, with a brainstorming effort directed at each part in turn.

It is recommended that the brainstorming group consist of a leader, a manageable number of panel members, and a secretary or two to record suggestions. (It is not unusual for suggestions to be offered at too fast a pace for one secretary to keep up.) Suggestions are apt to be richer if the panel members possess different backgrounds and interests. Some experts on brainstorming caution against including in the session the chief administrator or some other person holding a superior status over the others. The fear is that the presence of such a person will inhibit the other participants, making them less likely to suggest alternatives that are unconventional, playful, or otherwise likely to be viewed critically by the superior.

In preparation for the brainstorming session, the leader should inform the participants of the decision problem and the task for the group (that is, to identify a large number of decision options), provide a few (but not the best) examples of solutions, and indicate the procedural rules. These rules include prohibiting any critical comments, which tend to disrupt the creative tempo of the group. Questions are also frowned upon, because they frequently are evaluative in content. Also, ideas should be stated concisely, because evaluative judgments are apt to creep in during the elaboration of one's suggestion.

During the session, the leader's goal is to keep ideas flowing. Free-wheeling suggestions and shooting wild are encouraged, for, as one writer put it, it is easier to "tame

down" than to "think up". Those who promote brainstorming take the view that quality of ideas will come with quantity, and that all types of alternatives, silly or serious, far-out or feasible, should be voiced. One tactic designed to increase the number of options offered is first to solicit all ideas that piggyback on the current suggestion before entertaining new ideas. To foster production, the leader should be prepared to deal with lulls by such ploys as repeating a few randomly chosen, previously offered suggestions, or by mentioning verbs that critically define the problem to serve as trigger words or seeds to plant new ideas.

An overview of operating principles for brainstorming is provided in Figure 3.3.

1. Decision Selected for Brainstorming

    a) Yields many solutions not readily known
    b) Sufficiently focused

2. Composition of the Brainstorming Group

    a) Is diverse in backgrourd
    b) Is homogeneous in status/power
    c) Has a manageable number (for example, 6 - 20)

3. Chairperson's Actions

    a) Prepares panel before brainstorming session
    b) Discourages judgments and questions
    c) Encourages ideas and persistence
    d) Sees that all ideas are recorded
    e) Solicits after thoughts

4. Panel member's actions

    a) Withholds judgments and questions
    b) States suggestions succinctly
    c) Generates ideas freely
    d) Persists at the task

Figure 3.3 Overview of brainstorming operating principles.

Panel members report that participating in a brainstorming session is both enjoyable and hard work, and can have such side benefits as increased morale and flexibility in thinking. Brainstorming can be useful not only to identify decision alternatives, but whenever suggestions are needed--for example, to identify criteria for judging the alternatives or to identify reasons for taking a particular course of action.

Taming the Ideas

Regardless of whether decision alternatives are arrived at through brainstorming sessions or through the other means suggested, these choices need to be reduced to a manageable number. Where applicable, the status quo and an alternative that is only incrementally different should be included. The latter is suggested for consideration, since studies of decision making find that many decisions represent strategies that differ only marginally from current practice. The remaining suggestions can be grouped, and the most promising option in each group selected for further consideration. How such further consideration might occur is described in the next chapter.

CHAPTER 4. DETERMINING CRITERIA

Once decision alternatives have been identified, a logical next step in the decision process is to consider the merits of each. DAP involve evaluating how well each of the decision alternatives measures up against important yardsticks or factors of value. In this primer, the factors, such as achievement gain and cost, that are used to evaluate decision choices are called "criteria", or "value dimensions". "Objectives" is not used here because the important criteria may be more inclusive than how well objectives have been met. Other terms for "criteria" that have restrictive meanings are "attributes", "characteristics", "aspects", "components", "features", "properties", and "performance parameters".

Whether a criterion is considered important depends upon what the decision choices are and upon who is judging the potential actions. If the alternatives are competing instructional programs, a school administrator may most value cost and community acceptance; a student may give priority to other value dimensions. If the decision choices are various disciplinary actions, different criteria, such as fairness and congruence with exisiting policy, might be viewed as most important.

Identifying decision alternatives (see the previous chapter) differs from determining criteria, in that originality and quantity of options are more important when the task is to identify potential decision choices. The best action to take may be one that is unlikely to surface unless effort is made to generate many original options. When the task is to determine criteria, however, only the criteria important enough to affect the decision are sought. Only a handful of value dimensions are likely to be needed. If a potential criterion doesn't come readily to mind, chances are good that it isn't important enough to be included while implementing the DAP.

Five suggestions for determining criteria are listed in Figure 4.1 and are discussed below.

Suggestions for Determining Criteria

1. Consider the best and worst features of each decision alternative. The special advantages and disadvantages of an option (for example, availability and size) can suggest important value dimensions. Consider also the consequences of NOT following a potential action.

2. Consider past experiences. Were decisions like this made before by you or others? What criteria used then or now seem important in retrospect? If the decision is to buy a product or to implement a program, what attributes are usually looked at in evaluating such products or programs?

3. Start with broad concerns; then narrower ones. One strategy is to determine broad criteria (for example, effectiveness) and then to specify component dimensions that most contribute to the broader criteria. This strategy leads to a hierarchy of criteria, with specific criteria emanating from more encompassing ones.

4. Employ a checklist of criteria. Frequently used criteria are mentioned in Figure 4.2. Reference to these, or other criteria suggested by them, can help prevent overlooking an important value dimension. Note in Figure 4.2 that DAP treat risk or uncertainty as a value dimension in its own right. If the chances of positive consequences from choosing one decision option are more uncertain than from following, for example, a more standard course of action, this greater risk would count against the first option when the two alternatives are evaluated.

5. Solicit advice from others. Who will be affected by the decision? What do they see as important criteria? Obtaining value judgments from groups of individuals that represent their true and informed opinions is not easy. Some cautions and a description of one approach for soliciting and consolidating the views of several individuals is discussed below.

1. Consider the best and worst features of each decision alternative.

2. Consider past experiences.

3. Start with broad concerns; then narrower ones.

4. Employ a checklist of criteria.

5. Solicit advice from others.

Figure 4.1 Suggestions for determining decision criteria.

1. Characteristics/Features

   acceptability
   attractiveness
   consonance with existing policy
   flexibility
   leverage
   protection of rights
   purpose
   quality

2. Requirements

   cash outlay
   facilities/space
   materials/supplies/equipment/maintenance
   personnel/training
   time

3. Implementation

   availability
   ease of implementation
   political viability
   transportability

4. Effectiveness (or changes in)

   achievement
   attitude/appreciation
   attrition/recidivism rate
   behavior
   felt or met needs
   interpersonal relationships
   long-term effects/durability
   numbers and audience served
   program content
   satisfaction
   sensitivity/awareness
   side effects/spin-offs
   structure of the organization or program
   value to society

5. Risk or uncertainty with regard to

   characteristics
   requirements
   implementation
   effectiveness

Figure 4.2 Illustrative criteria for judging decision alternatives.

Determining Value Positions from Others

Decision criteria are not "right" and "wrong" as such. They represent individuals' values about what are the important dimensions against which to judge potential actions.

> ..in the search for jointly acceptable (criteria), conflict and cooperation are intimately linked together. The existence of conflict promotes cooperation by giving rise to the need for it. (Radford, 1977, pp. 74-75.)

Decision making is made simpler when a consensus can be reached about criteria, but a consensus is not always possible, nor desirable, when true value differences exist. The DAP attempt to reach agreement about the value dimensions and their relative importance, but they do not require agreement. Consensus may often be more illusory than real when it is obtained in a traditional group meeting format. Members may engage in "group think" in which the desire to achieve consensus overrides the members' willingness or motivation to pursue conflicting positions. In face-to-face meetings, not all viewpoints might be expressed, because of the reluctance of some members to speak out in the presence of superiors, because of hesitancy to put forth thoughts that are feared to be unpopular or stupid, because of domination by the leader or by other participants, or because not all constituencies are represented at the meetings.

The Delphi technique, or any of several variations of it, has been suggested in part as a way of reducing the distortion of views that face-to-face group meetings can foster. Although originally developed as a method for forecasting future events, often in situations where little data were present, more recent applications generally share only these two features:

1. Several respondents present their views independently and anonymously.
2. Feedback is provided to the respondents, who are asked to reevaluate their original answers.

For purposes of determining criteria to judge decision alternatives, the following modified Delphi technique is suggested. First, using approaches suggested in Figure 4.1, the leader formulates and distributes a list of possible criteria. The criteria should be clearly worded. Definitions and/or examples might be added to increase accurate communication of meaning. Second, respondents are asked, independently and anonymously, to suggest other criteria, to rate the criteria on importance without regard to how difficult the criteria might be to measure, and to give reasons for their ratings. Third, the leader summarizes the responses and circulates a revised list of criteria for further ratings.

A compromise between this modified Delphi procedure and the usual group meeting is to have the discussion take place face-to-face, but still retain the anonymous voting. A talk-judge pattern is followed. Leaders should encourage all to speak ("I'd like to hear from each of you"), should remain impartial, and should prompt participants to be devil's advocates, so that many views and suggestions have a hearing.

The goal of the Delphi and similar techniques is not necessarily consensus, although relative agreement can be a facilitating consequence. Rather, the procedures alert participants to a variety of viewpoints and challenge the participants' values and the assumptions on which they rest.

CHAPTER 5: APPLYING DECISION AIDS

> They know the cost of everything and the value of nothing.
>
> Ansel Adams, nature photographer, referring to President Reagan and Secretary of the Interior James Watt

In this chapter, it is assumed that those participating in making the decision have identified two or more potential decision actions, and have described two or more important criteria (dimensions of value). (If only one criterion is evoked, the decision process is trivial. The decision-maker merely selects the decision alternative that scores best on the single criterion of relevance.) The DAP include aids for evaluating each option against each criterion. The procedures to be described resemble most closely those suggested by Gardiner and Edwards (1975); Edwards, Guttentag, and Snapper (1975); Edwards (1977); and Einhorn and McCoach (1978). However, a great number of other procedures and variations have been proposed in the technical literature. Some of these techniques are mentioned and referenced in Appendix A.

The decision aids included in the DAP are methods that have met the following five criteria:

1. Are relatively simple to use.
2. Yield good approximations to results obtained from more exacting methods.
3. Are appropriate for most educational decisions.
4. Lead to the same options being evaluated best, regardless of what other lesser alternatives are considered.
5. Provide insight about the decision situation.

Overview of the Decision Aids

The steps in evaluating a decision alternative are implied by the form shown in Figure 5.1. A separate form is used for each option being considered. Once an alternative has been identified

at the top of the form and the criteria described in the left-most column, the next step is to assign weights to the criteria by entering numbers in Column A of Figure 5.1. Failure to do so would amount to giving each dimension equal importance. The same criteria and column of weights are used on each form.

Alternative: _____

_____

_____

_____

	Criteria	A Weight	B Estimated Outcome	C Estimated Value	AxC Weighted Value
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
				Value Indicator	

Figure 5.1 A form for valuing a decision alternative.

DAP require that those participating in the decision making are able to project the future consequences of alternative decisions prior to their selection and implementation. This requirement is implicit in even casual, nonanalytic decision-making procedures. In DAP the projected consequences, with respect to each of the criteria, are placed in Column B. For example, if achievement loss is one criterion, and if the alternative under consideration is estimated to result in a loss of six standard score units, then the number six would be entered in the appropriate row of Column B.

The numbers in Column B will be in different units. Some may be in standard score units, others in dollars, still others in rating scale points, etc. For reasons described later in this chapter, the validity of the DAP requires that the estimated outcome entries be converted to a common yardstick of value. The results of this conversion are placed in Column C.

Finally, the total estimated value for the alternative needs to be calculated and compared with the corresponding value indicators for the other potential decision actions being considered. The option with the greatest value indicator is the one recommended for implementation.

Applying decision aids involves making numerical estimates and manipulating these numbers. The mathematical results may appear to be exact and correct. The DAP user should not attribute more precision to the numerical values than they deserve, but neither should the values be treated as worthless and ignored. Political polls are frequently off by many percents, but the numbers are valuable, nonetheless. The validity of the DAP rests in part on the belief that it is better to operate on the best information and judgments available, even though they may be in error, than to take the position that, because uncertainty and inaccuracies are likely, numerical estimates should be disregarded.

The steps of applying decision aids are listed as the main categories of Figure 5.2. Specific methods for their execution are provided later in this chapter.

1. Allocate importance weights to the criteria.

   a) Assign a weight of 100 to the most important criterion.
   b) Give lesser weights to other value dimensions, depending on their judged worth relative to the most important criterion.
   c) Compare each secondary criterion with the other secondary criteria and adjust initial weights as warranted.
   d) Allot weights to components of more global criteria.
   e) Delete criteria with very low weights.
   f) Perform separate analyses if near consensus on weights is not reached.

2. For each decision alternative, estimate outcome with respect to each criterion.

   a) Solicit best advice.
   b) Gather needed data.
   c) Perform separate analyses if near consensus on expected outcomes is not reached.

3. Convert outcome measures to a common scale of value.

   a) Identify minimum and maximum plausible outcomes for each criterion.
   b) Construct a value function over the range of plausible outcomes.
   c) Obtain the value scale amounts from the value function.
   d) Perform separate analyses if near consensus on value functions is not reached.

4. Compute an overall value indicator for each decision alternative.

   a) Multiply a criterion's weight and expected value.
   b) Sum these products over all criteria to obtain an overall value indicator.
   c) Compare the overall value indicators of the decision alternatives.
   d) Choose the alternative with the greatest value indicator if the indicator is significantly higher than those for the competing options.

Figure 5.2 Steps in valuing decision alternatives.

An Example

To help illustrate the methods, the following example will be used. A school district, faced with reduced federal, state, and local support for its compensatory educational program, identified five ways, which are consistent with state regulations and local contracts, for cutting back on the program to bring it within the budgetary limits. The options are:

1. Serve fewer students by changing the cutoff score for qualification into the program slightly for reading and more dramatically for mathematics.
2. Serve fewer students by dropping some (higher) grade levels and schools.
3. Reduce instructional time from five to three days per week.
4. Reduce the number of aides needed by increasing the in-class student to staff ratios and by establishing independent learning laboratories.
5. Reduce the number of professional staff needed by increasing class size and by greater use of teacher aides.

We shall assume that each of these options, and perhaps some combinations of them, have been described in detail. Those participating in the decision also described the following criteria against which to judge the decision alternatives.

1. Achievement loss.
2. Congruence with local policies.
3. Ease of implementation/practicality.
4. Support/acceptability of:
    a) aides,
    b) parents/community,
    c) students,
    d) teachers/principals.
5. Side effects (good or bad) expected.

Cost was not included as a criterion in this example, because all options were designed to fit within a fixed budget. Since the options were equivalent with respect to cost, cost could not be a basis to evaluate the relative merits of the options.

Weighting Criteria

Not all the criteria will be judged equally important. Thus, it is recommended that importance weights be assigned to the criteria. A procedure that has worked well is to assign a weight of 100 to the most important criterion, and lesser weights to the other value dimensions depending upon their judged worth relative to the most important criterion. In the compensatory education example, support/acceptability was viewed as most important and received a weight of 100; congruence with local policies and ease of implementation/practicality were seen to be half as important as support/acceptability and each received a weight of 50; achievement loss was considered only one-fifth as important and received an importance rating of 20; etc. (See Figure 5.3) Once an initial set of weights has been assigned, it is advisable to consider other pairings and, perhaps, make some warranted adjustments. For example, ease of implementation, with its weight of 50, might be compared with achievement loss (weight = 20) to consider whether the 50 to 20 (2.5 to 1) ratio still seems reasonable.

Note that all components of support/acceptability were initially treated as a group, both to simplify the weighting task by reducing the number of initial ratings and to increase accuracy by reducing the tendency to overweight a set of conceptually interdependent criteria. Those participating in the decision process now need to divide the 100 points of weight for support/acceptability among the four components. The results of this allocation are also shown in Figure 5.3.

At this point, consider eliminating one or more criteria that have small weights (less than 3% or 5% of the total of all the weights). Their contribution will be negligible and will not materially affect the final judgments. In the example, side effects was eliminated from the analysis that followed, since its weight of 5 was only 2.2% of 225, the total of all the weights. It is because a large number of criteria cannot all carry a heavy weight that the recommendation was made in Chapter 4 to limit the

Alternative: Serve fewer students by changing the cutoff score for qualification into the program slightly for reading and more dramatically for mathematics.

Criteria	A Weight	B Estimated Outcome	C Estimated Value	AxC Weighted Value
1. Achievement loss	20	6	60	1200
2. Congruence with local policies	50	2½	83	4150
3. Ease of implementation/practicality	50	5	100	5000
4. Support/Acceptability of:	[100]			
5. aides	12½	6	86	1075
6. parents/community	25	6	86	2150
7. students	12½	7	100	1250
8. teachers/principals	50	6	86	4300
9. Side effects	5	— Dropped from analysis —		
10.				
11.				
12.				
			Value Indicator	19125

Figure 5.3 A completed form for valuing a decision alternative for the compensatory education example.

criteria to those few considered important enough to affect the decision. As is the case with the example, roughly 6-8 seem a good number of value dimensions; twice as many would be too many.

Three methods for obtaining the weights are: (1) by voting, (2) by verbal bargaining, and (3) by delegating the task to a single person. Consistent with the procedures recommended for determining the criteria by soliciting advice from others (see Chapter 4), it is suggested that the weights be obtained by voting, with discussion between rounds of voting.

What if the voting procedures do not lead to general agreement? In such a situation, separate analyses can be carried out, one for each distinct set of weights. Frequently the final results will not differ materially regardless of which set of weights is used. Even if the final results do differ, it is nevertheless very instructive to learn how the overall value indicators of the decision alternatives are affected by basic disagreements over the importance of the criteria. At best, the DAP can provide only increased illumination, not miracles that make conflicting value assumptions disappear.

Estimating Outcomes

No one knows for sure what will happen if a particular course of action is followed. "...all actions in the real world are shrouded in uncertainty. The question is merely one of learning to live with uncertainty." (Bross, 1953, p. 26) One way to live with uncertainty is to make uncertainty itself the attribute to be estimated (see Appendix A); a second way, and the method chosen here, is both to treat extreme uncertainty or risk as a value dimension (see Figure 4.2) and to make the best estimates one can about the consequences of the decision alternatives.

Unlike the steps of determining the criteria and assigning relative weights, where individuals' values are important and diversity of opinion is respected, the step of estimating outcomes is one for informed judgment. The best advice and data are sought about what consequences can be expected if a

particular course of action is implemented. What does previous experience tell us? What do experts and others predict the outcomes will be?

Isn't estimating outcomes subjective? Yes, it often is, but being subjective does not mean the estimation must be biased. When large differences of opinions about the expected outcomes do exist, more information should be gathered (see Figure 2.1). When large differences in expectations remain, separate analyses using different expected outcomes can be conducted to ascertain the effect that these disagreements over predictions may have regarding the overall value indicators of the decision alternatives.

The entries in Column B of Figure 5.3 are the estimated outcomes for the compensatory education example. The entry for the achievement loss criterion of six is in normal curve equivalent units, a type of standard score; the entry for congruence with local policies is based on a 3-point rating scale (3 = completely congruent with local policy, 1 = conflicts with local policy in an important way); the entry for ease of implementation/practicality is based on a 5-point scale (5 = easy to implement, completely practical); and the entries for support/acceptability represent ratings on a 7-point scale (7 = fully supportive completely acceptable).

Criteria for other examples of decisions might be attendance and usage (measured by frequency counts), time (hours), space (square feet), etc. Cost, an important criterion for many decisions, is difficult to measure, partly because many factors contribute in complex ways to the calculation of cost. A brief discussion of the measurement of cost may be found in Appendix B.

Connecting Outcomes to Common (Value) Units

It may seem odd that outcomes as diverse as achievement loss, congruence with local policies, etc., can be placed on the same scale of value. Yet, if you think about it, we compare the value of diverse entities all the time. Would we rather spend our money seeing Aunt Mabel or buying a new set of golf clubs? We

can judge whether a hand-crafted pitcher has more value to us than an equally priced private tennis lesson by noting which one we choose.

Money is a numerical index that makes it possible to compare the "value" of a wide range of commodities and services on the same scale. But money is an imperfect measure of value. Most of us would prefer to win a sure $10,000 than to have a 50/50 chance of winning either $0 or $20,000, even though the expected winnings of the latter arrangements are also $10,000. That is because the value to us of the second $10,000 is less than the first $10,000. The relation between money and value in this case is shown in Figure 5.4, where equal changes in dollars do not correspond to equal changes in values.

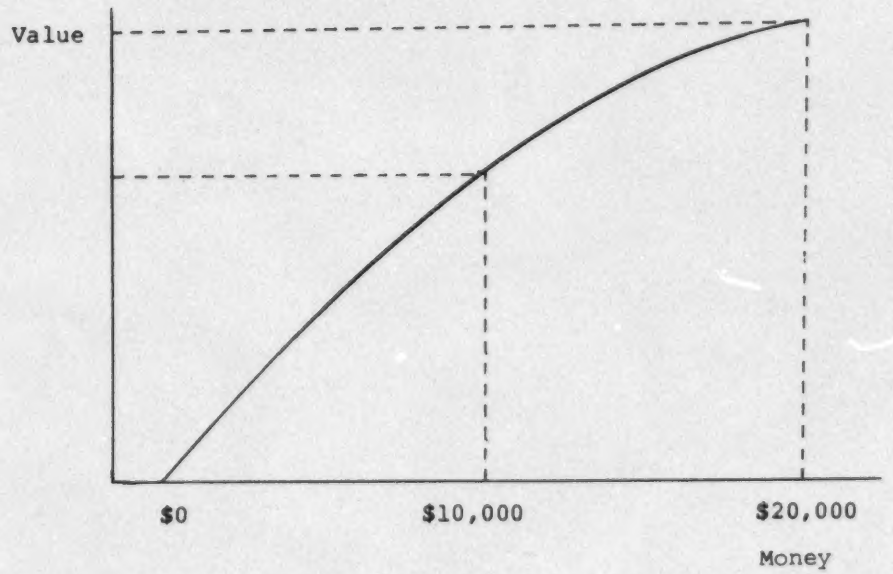

Figure 5.4 A value curve for money.

The nonlinear relation that may exist between the units that outcomes are measured in and the value of the outcomes is one reason why outcomes need to be converted to common value units. The distortion caused by using unconverted units is even worse when the relation is shaped like an upside down U. For example, if the criterion is length of the class period, too long a time or too short a time is less valued than an intermediate length. Without changing time (in minutes) to a value measure, decision options that called for long class periods would be rated higher on the criterion than options that called for intermediate length class periods.

Perhaps the most important reason for converting outcome units to common value units is to protect the integrity of the criterion weights. The true weight a criterion carries depends upon the variability of the outcome measures. Converting outcomes measures into the same value scale has the effect of reducing differences in variability among the criteria and, thus, in turn, preserving the intended relative weightings of the value dimensions. If, arbitrarily, cost were measured in pennies instead of dollars, so that the cost entries were 100 times larger (500¢ versus $5, for example), cost would have a weight 100 times larger than if cost were measured in dollars. A rating scale from 1 to 10 would likely count twice as much as a scale on the same criterion that went from 1 to 5.

The following simple 3-step procedure is suggested for converting any expected outcome units to the common value scale. First, identify minimum and maximum plausible outcomes for each criterion. For example, in considering how the achievement of the present students might change under various cutback programs, one might estimate that the worst plausible consequence would be a 15-point drop and the best plausible consequence would be no drop at all. (See Figure 5.5.)

Second, draw a value function for each option. This can be done merely by constructing a straight line between two points, one in which the worst plausible outcome is given a zero value

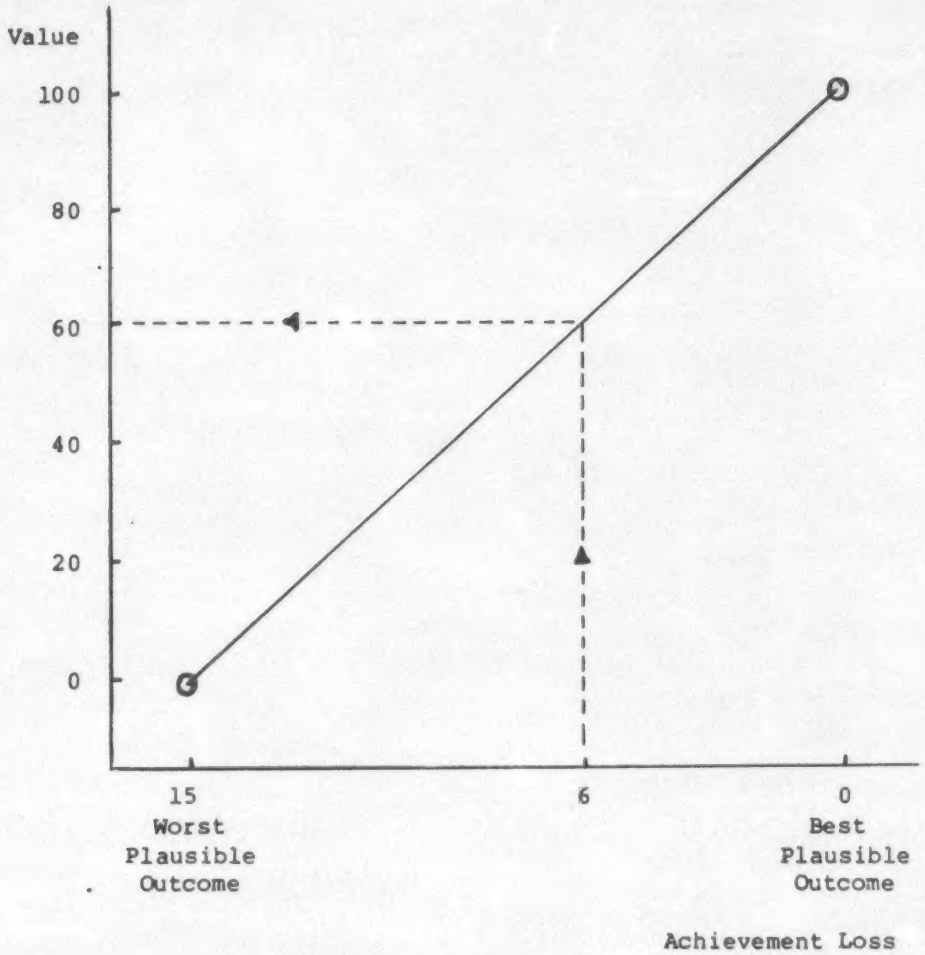

Figure 5.5 A value curve for achievement loss.

and one in which the best plausible outcome is given a value of 100. (For illustration, the two points are made extra large in the example of the achievement outcome shown in Figure 5.5.) A straight line value function is often a good approximation, especially when each additional unit on the expected outcome measure is considered to correspond to approximately the same increase in value. However, other shaped curves can be drawn by hand between the points if there is reason to believe that the value does not rise essentially at a steady rate. A curve like that shown previously in Figure 5.4, an elongated S curve, or an

inverted U curve might seem appropriate. Whether the curve is a straight line or is sketched to form some other shape is a matter of the decision makers' judgment.

Third, read the value figure for a given outcome measure directly from the curve. For example, an achievement loss of six standard score units was expected under the first option considered (see Figure 5.3). From the curve shown in Figure 5.5, we see that a 6-point loss corresponds to a score of 60 on the value scale. Note: if the value function is a straight line, the value indicator can be calculated, instead of read off a graph, using the formula:

$$\text{Value Indicator} = \frac{\text{expected outcome - worst plausible outcome}}{\text{best plausible outcome - worst plausible outcome}} \times 100$$

For our example,

$$\text{Value Indicator} = \frac{6 - 15}{0 - 15} \times 100 = \frac{-9}{-15} \times 100 = 60.$$

Remember, the above formula is appropriate only if the value function is a straight line.

Once again, if those participating in the decision making substantially disagree over the appropriate value function, separate analyses can be conducted that use the different functions.

Compute Overall Value Indicators

The computation of the value indicator for each decision alternative is a mechanical step. The value indicator for an alternative is merely the sum, over all criteria, of the weighted estimated values. The overall value indicator in Figure 5.3, for example, was calculated by multiplying the entries in Columns A and C for each row, and summing the products.

Finally, the value indicators for each decision alternative can be compared. Do not be seduced by the false precision of the numerical values. If the highest scoring option does not rate, for example, 10% or so above the next contender, further

discussion of the decision problem would be in order. Becaus the DAP are explicit, they will highlight where the differenc do occur and this, in turn, can be expected to improve communication among the parties and, ultimately and hopefully the quality of the decisions that are implemented.

Summary

This chapter contains suggestions for evaluating decision options with respect to several criteria. A separate form similar to that shown in Figure 5.1 is completed for each alternative choice of action being considered by the decision makers. The steps for completing the form are outlined in Figure 5.2, and an example of the completed form is provided Figure 5.3.

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SUGGESTED READINGS*

Survey of Analytic Decision Models

Bross, 1953. Written in an almost breezy style, this book provides a relatively simple introduction to the field of analytic decision making.

Hwang & Yoon, 1981. A state-of-the-art review of current techniques for evaluating multiple alternatives against multiple criteria. Ample references and descriptions. Highly technical.

Miller & Starr, 1967. Some would classify this reference as a classic textbook on analytic decision making. It lies between the Bross and the Hwang & Yoon works in both coverage and required mathematical sophistication.

Steps in Valuing Decision Alternatives

Edwards, 1977. Suggests procedures for applying decision aids that are very close to those offered in Chapter 5. The reference contains several examples in which the procedures were applied in practice.

Decision Making Under Conflict

Radford, 1977. Considers analytic decision making within political and organizational contexts in which goals and values are often in conflict.

Decision Making Under Uncertainty

Fischhoff, Goitein, & Shapira, 1981. A review of the research literature of decision making models that take into account the probability of the occurrence of all possible consequences if a given course of action is followed.

Delphi Technique

Linstone & Turoff, 1975. This edited volume includes not only descriptions of the Delphi technique, but also many examples of its use.

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* See the reference list for complete citations.

Cost Analysis

Haller, 1974. An extremely readable introduction to the concepts and principles of the analysis of educational costs.

Levin & Seidman, 1981. An introduction to cost analysis in education. Contains some worked examples.

APPENDIX A: ALTERNATIVES TO DAP

> Sophie kept her eyes shut as the flow...moved its way up through the tributaries of her mind, nearly drowning her reason.
>
> William Styron, Sophie's Choice

Analytic approaches to decision making is the subject of over 300 articles yearly in journals of such fields as economics, psychology, management science, information science, and operations research. A brief, but amply referenced, history of behavioral decision theory for the case of several criteria is offered by Starr and Zeleny (1977).

Variations can be found for implementing each of the steps in the DAP. For example, Eckenrode (1965) describes six ways of assigning importance weightings to the criteria. To convert expected outcomes to values, many authors recommend that a decision analyst present the decision maker with a series of hypothetical choices between varying levels of two different outcomes. The preferences expressed permit the analyst to construct conversion curves similar to Figure 5.4. See Keeney and Raiffa (1976, pp. 96-99) for a worked example.

In cost effectiveness studies, criteria that can be converted to dollar values are separated from other (effectiveness) criteria. For each decision alternative, ratios are then formed in which costs (in dollars) are compared to effectiveness (in common value units). The DAP can be followed to obtain an (effectiveness) value indicator for each option, and that indicator can be used in the cost/effectiveness ratio.

The DAP require that the expected outcomes be converted to a common value scale. Methods for picking the "best" decision alternatives that do not require this conversion are:

1. Look to see if one option is better than all the others on all criteria. If so, pick that option. If not, use another method.

2. Choose the option that is clearly best on the most important criterion. Ties are broken by considering the second most important criterion.

3. Establish a minimum outcome on each criterion that is, nevertheless, still satisfactory. Pick any decision alternative whose outcomes are expected to exceed all the minimums.

4. Assign a score to each possible outcome on each criterion. The sum of the scores over criteria is the value indicator for a decision option. This procedure, good for repetitive decisions, is followed by many bank officers in deciding whether to approve loans. For example, two points if married, one point if lived in the same residence for over three years, five points for income in the $30,000-$40,000 range, etc.

In the behavioral decision making literature, a distinction is made between decision making under certainty, decision making under risk, and decision making under conflict. The DAP, and the methods above, fall into the first category, because one acts as though one is certain about the outcomes or consequences of taking the potential actions under consideration.

In decision making under risk, the decision problem is conceptualized as branches from a tree or tributaries from a river, in which the initial branches or tributaries represent choices and the paths emanating from each choice carry the probabilities that the several possible consequences of following the course of action will occur. Thus, decision making under risk requires not only that outcomes and values be estimated, but that the probabilities of the outcomes be estimated as well. See Keeney and Raiffa (1976) for a classical textbook on this approach.

In decision making under conflict, it is assumed that the outcomes are, in part, under the control of rational opponents. The theory of games addresses itself to decision making under conflict. "Games", however, in this context does not suggest playfulness, as many serious decisions in times of war, in business competitions, etc., are of this type.

The decision problem can be conceptualized as other than picking the best single option out of several, explicitly stated options. Instead, the decision problem might be more a design problem; namely, to construct a single option that contains the best combination of design elements. In the compensatory education example, the task might be to design the optimum mix of class size, use of materials, deployment of teachers and aides, inclusion of grades and subjects, etc., to provide the most value for the money available. Such a problem is a classical linear programming problem.

Another conceptualization of the decision problem is that the problem is to pick not one but a combination of available options that together maximizes value. An educational example is the decision of which schools to keep open and which to close. One set of procedures for handling such a problem is provided by Wholeben (1982).

APPENDIX B

THE MEASUREMENT OF COSTS

The following statements represent important principles about the definition and measurement of costs. Excellent introductory treatments of the topic are presented by Haller (1974) and by Levin and Seidman (1981).

1. Costs result from decisions. In one sense, textbooks, teachers, and facilities do not have a cost; rather it is the decision about these things that has a cost: to adopt one textbook over another, to employ a particular staffing pattern, and to build a new school rather than renovate an old one.

2. Costs are "anything and everything" you need to implement one course of action over another.

3. Costs include expenses for personnel, facilities, equipment, materials, and services. A more detailed list of cost-generating items is given in Table B.1.

4. Most economists consider as costs the time of students, teachers, parents, and others. Economists argue that if one option requires more time of people than another, the extra time could have been spent in beneficial activities, and that these "foregone benefits" are a cost to the less time efficient option. Because of the difficulty of converting to dollar amounts the foregone benefits resulting from loss of time, DAP treat time as a separate criterion that is valued in the same way as other criteria.

5. What counts as a cost to a program depends upon whose viewpoint is taken. For example, the cost of the federal subsidy of a compensatory program is considered a cost from the federal government's point of view but not from the school administrator's point of view.

6. In judging alternative options, it is necessary to consider only the costs of elements that differ among options. If all options, for example, require the same space, the cost of such space does not serve to differentiate among the options and can be ignored.

Table B.1

Resources or Cost-Generating Activities
Included in Project Cost

Acquisition Cost	Operational Cost
Design of project	Project direction
Development of materials	Evaluation
Evaluation design	Management support
Project implementation	Salaries
	Teachers
Equipment purchase	Paraprofessionals
Project-related	Specialists
Student-related	Other
Materials and supplies	In-service training
Project-related	
Student-related	Materials and supplies
	Project-related
Pre-service training	Student-related
Facilities (space)	Equipment
	Replacement
Installation of equipment	Maintenance
	Facilities operation & maintenance
	Contracted services
	Media services
	Transportation

Source: Haggart, 1978.

7. Costs lie in the future. If a program requires certain equipment or facilities you already have, the "sunken" cost for acquiring the equipment or facilities is not counted in the cost of the program.

8. Competing decision actions may be expected to have a different pattern of costs over time. Some may have lower initial costs; others lower cost in subsequent years. A proper comparison of the costs of competing options, therefore, requires an aggregation of the yearly costs to a common point in time. Computing the present value of the cost of the decision alternatives is recommended.

9. The time frame for judging costs is important. The interest rates assumed in the calculations are important. The relative attractiveness of alternatives depends on the assumed program length and interest rates. Several calculations, each based on a different set of assumptions, are advised.

10. Several techniques are available for pricing a good or service. Five of these techniques are shown in Table B.2.

Table B.2

Valuation Techniques

Technique	Definition	Conditions for Use
Market Prices	The price for an ingredient in the open market.	For market goods
Shadow Price	The value of the sacrificed alternatives as indicated by: a) the price of an approximate market or other equivalent for a non-market good b) people's willingness to pay for an ingredient	For non-market goods
Joint Costs	The proportion of an ingredient's value allocated to the alternative under consideration	For ingredients that are put to multiple uses
Annualized Costs	An equal payment made annually that accounts for multi-year projects and foregone interest	For ingredients with life spans of more than one year
Present Value	A single figure for a stream of future costs discounted at the appropriate interest rate	For ingredients that have ongoing costs

Source: Levin and Seidman, 1981.